PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1954-55

COTTON RESEARCH STATION
NAMULONGE, UGANDA

PUBLISHED BY

THE EMPIRE COTTON GROWING CORPORATION

12 CHANTREY HOUSE, ECCLESTON STREET,
LONDON, S.W.1.

1955

COMMONWEALTH MYCOLOGICAL INSTITUTE
3 DEC 1955

PROGRESS REPORTS FROM EXPERIMENT STATIONS.

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For the 1954-55 season and subsequently the Progress Reports published in this series will be confined to those from territories in which members of the Corporation's staff are working. For 1954-55 the list will be:—

Cotton Research Station, Namulonge,
Sudan,
Kenya,
Tanganyika—Lake Province,
Tanganyika—Eastern Province,
Nyasaland,
Northern Nigeria,
Aden,
West Indies,
Survey of Reports.

COTTON RESEARCH STATION, NAMULONGE

PROGRESS REPORT FOR THE SEASON 1954-55

	Cotton	*Food Crops*
Sowing	June-August	February-April
Flowering	September-November	—
Reaping	December-March	May-August

Introduction

BY

J. B. HUTCHINSON.

The Namulonge Advisory Board met on 15th December, 1954. The presence of Sir Geoffrey Clay, Agricultural Adviser to the Secretary of State for the Colonies, was much appreciated. Territorial representatives were present from Kenya, Nyasaland, Tanganyika and Uganda. The usual tour was made of the farm and of the laboratories, and valuable informal discussions followed the meeting.

Mr. D. MacDonald left in December 1954 on retirement after long and able service as a plant breeder. Mr. H. L. Manning took charge of the Plant Breeding Section on his departure, with Mr. R. C. Faulkner, who arrived in September, 1954, on first appointment, as his assistant. The Plant Pathology Section was strengthened by the arrival of Mr. C. Logan in July, 1954, on first appointment.

Mr. D. E. B. Kibukamusoke was given a further year's leave of absence to continue his plant breeding studies at Cambridge on a Colonial Development and Welfare scholarship.

Co-operation with the Makerere College Faculty of Agriculture has continued. Mr. Prentice is a member of the Faculty Board, and has conducted farm classes. Mr. Coaker acted as an external examiner. Mr. Stephens continued his farm classes, and has maintained the Makerere herd. Farm classes have also been given by Mr. Bisase. Dr. M. A. Keay, of the Makerere staff, lived and worked on the Station for some months.

Visits were paid by members of the staff to the following territories:

Tanganyika, Ukiriguru—Mr. Le Mare, Mr. Evenson, Mr. Logan.
Belgian Congo—Dr. Wickens.
Sudan—Mr. Le Mare.
Kenya, Kisumu—Dr. Hutchinson, Mr. Coaker.

Mr. Le Mare attended the 2nd Inter-African Soils Conference and the 5th International Congress of Soil Science at Leopoldville.

Mr. Prentice and Mr. Le Mare attended the Specialist Committee on Soil Fertility at Muguga in Kenya. Dr. Hutchinson attended the Maize Breeders Meeting at Muguga.

Dr. Hutchinson and Mr. Manning visited America on visiting professorships to the University of North Carolina. Dr. Hutchinson toured the United States Cotton Belt at the invitation of the National Cotton Council of America.

The Uganda Crop

BY

J. B. HUTCHINSON.

The season was a most disappointing one. Plantings throughout the Protectorate were within the normal range. Total acreage was rather greater than in 1953 both in Buganda and in the rest of the Protectorate. There were, however, important differences in time of planting. June plantings in 1954 fell badly behind 1953 in Buganda, Busoga and the rest of the Eastern Province. On the other hand, late plantings (August and September) were up on 1953 everywhere. It is particularly noteworthy that in the S47 area 48,000 acres were planted in September in 1954, as against none in 1953, and in the BP52 area the September plantings in 1954 exceeded those in 1953 by 7,000 acres.

Taking into account both acreage and sowing date, crop expectation at the completion of sowing was not very different in 1954-5 from that in 1953-4. Early growth was retarded in many areas by heavy rain and cool weather. This was followed in Buganda by cool and cloudy dry weather and by the end of November it was apparent that the Buganda crop was likely to be considerably reduced by the mid-season drought. At the end of the season there were heavy rains that persisted through the picking season. The early crop was damaged by rain when it opened, and the late crop failed to take advantage of the unexpected moisture. Crop estimates at various stages were approximately as follows:

October	375,000 bales
November and December ...	360,000 bales
January	320,000 bales
February ... ... Barely	300,000 bales

At the end of the buying season the equivalent of 300,000 bales had been bought.

Seed sufficient to plant a little more than half the total acreage was dressed with Perecot 45 in batch mixers. It was reported that blackarm was worse in crops grown from undressed than from dressed seed, particularly in the BP52 area, although the effect of treatment on yield was not so large as to suggest that the disease was of prime importance this season.

No seed movements were undertaken for the 1954-5 crop, but a Namulonge multiline strain of BP52 known as NC54 was multiplied on experiment stations, and on areas under the control of the Agricultural Department.

The Farm

BY

B. E. M. PETIT.

The expansion of the farm during 1954-55 resulted in a total increase of 126 acres under control. Of this, 76 acres are in the arable area and the balance in permanent pastures. The 690 acres of Namulonge now under control consist of:—

Arable:		
Cropped in 1954-5	306 acres	
Grass ley	47 acres	
Cleared in 1954-5 but not cropped ...	26 acres	
Paths	41 acres	
		420 acres
Permanent Pastures:		
Paddocks	116 acres	
Housing area (grazed)	60 acres	
		176 acres
Afforested:		
Gum plantation		40 acres
Housing, laboratory, and steading areas (not grazed)		55 acres
Total		691 acres

The arable area, much of which was cropped twice during the year, provided 75 acres of cotton, 87 acres of first and 8 acres of second rains maize, 37 acres of sunflower, 16 acres of first and 69 acres of second rains beans and the balance in cassava, sweet potatoes and groundnuts. Of the cotton area, 48 acres were planted with breeding stocks of BP52 and the new multiline strain of BP52 known as NC54. The latter was under multiplication for commercial issue. Acreages and total yields were as follows:

Breeding stocks ...	... 15 acres	giving 5,277 lb. seed cotton.
Farm multiplication areas	22 acres	giving 8,611 lb. seed cotton.
Rotation experiments	... 11 acres	giving 3,155 lb. seed cotton.

These figures underestimate yields per acre somewhat, as no account is taken of experimental treatments—e.g. late planted plots—and such technical factors as the removal of guard rows from areas used for experimental purposes. Nevertheless, a comparison of these data with those for the previous season (1953-4 report, p. 2) indicates that yields in 1954-5 were less than half those in 1953-4.

1954-5 was a particularly poor year for Namulonge. The rainfall distribution was bad, especially in the second half of the year. Not only was the farm cotton crop bad, averaging only about 400 lb. seed cotton per acre, but second rains maize failed altogether, and some of the acreage planned for other crops in the second rains was never sown.

A second block of land on the Nalumuli farm, having completed its cycle of three years cropping, was sown down to a grass ley early in the year. In one strip the *Chloris gayana* seed was sown under an upright variety of cassava and produced quite a good sward despite the shade effect of the cassava and the disturbance as a result of the subsequent digging up of that crop. A sixth clearing having been added, this farm is now complete.

A pair of strips on the Kirimantungo farm and another pair on the Sendusu farm were also sown with *Chloris gayana.*

The labour position was considerably improved by the introduction of prison labour. The Central Prison at Luzira started a prison camp at Namulonge for first offenders, and good conduct convicts who were nearing the end of their sentence. Accommodation was provided by fencing-in eleven of the houses in the labour lines, and allocating four more of these and three Married Quarters for the prison staff. Thus we have been provided with a permanent labour force of 100 to 140 convicts. This, however, has not affected our demand for local labour.

Building projects completed during the year consist of a staff bungalow, one 20,000 gallon irrigation tank, two airtight grain tanks with a capacity of 7 tons each and two lofts in the produce stores.

The livestock had a disappointing year. Of the seventy calves which were born twenty-seven died, which represents a much higher than normal calf mortality. Thirty bullocks were taken over from the Stock Farm, Entebbe, on a "pay on survival basis". These arrived in very poor condition and coming from a "clean" farm quickly contracted East Coast fever. Fifteen died of this disease and one of snake bite. Thirteen adult animals were slaughtered and sold for meat.

The grass leys continued to carry over $1\frac{1}{2}$ beasts per acre throughout the year inclusive of the drier months. For much of the year, the stocking rate was much higher. Namulonge continued to look after the Makerere herd of cattle.

Climatology

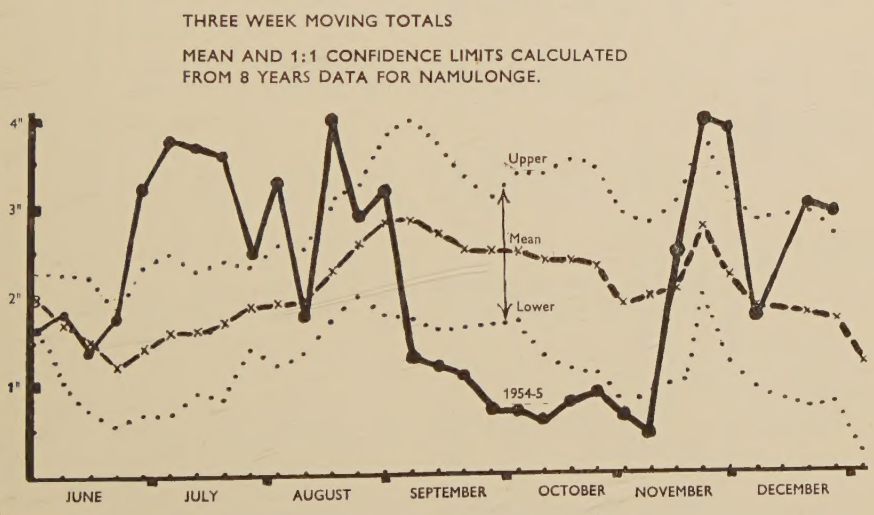
BY

H. L. MANNING AND H. G. FARBROTHER.

Standard meteorological data are summarised in Table 1 overleaf, subdivided into the cotton season and the 1955 food crop season.

It will be seen that the total rainfall for the period June, 1954, to January, 1955, amounted to 28·46 ins., well above the average for the cotton season. In spite of this considerable total, cotton yield levels were very low, and much of the second rains food cropping failed entirely. It is therefore necessary to examine in greater detail the pattern of rainfall in comparison with other years. In Figure 1 the mean, upper and lower limits, (3 week moving totals, 1 : 1 confidence limits) calculated from the eight years of records now available for Namulonge, have been superimposed over the three weeks moving total for this season.

FIG. 1. Rainfall Distribution June 1954—January 1955



Clearly the distribution was most unusual, although the number of rainy days with >0·01 ins. was quite normal. At Namulonge during September and October, there were as many as 26 rainy days with >0·01 and a further 9 days on which a "trace" was recorded, but the total precipitation amounted to only 3·32 ins. Cloud cover and evaporation figures were also not abnormal (see Table 2) during September and October. Table 2 compares the summarised meteorological data for September, October and November, 1954, with those of 1953.

TABLE 1.

SUMMARY OF METEOROLOGICAL DATA FOR 1954-5.

	Rainfall		*Evaporation*		*Relative Humidity*		*Sunshine*		*Air Temperature °F*		
	Ins.	*Days* >0·01	*Open Pan Standard* 48″	*Recorder* 36″	*a.m.*	*p.m.*	*C.S.*	*Callender*	*Max.*	*Min.*	
June 1954	2·82	12	4·90	3·85	85·3	62·3	6·07	640·1	80·7	61·5	1954-5 Cotton Season
July	5·26	12	4·31	3·20	88·6	62·3	5·41	546·7	79·4	59·9	
August	4·51	10	4·26	3·67	86·4	61·5	5·28	606·0	79·4	60·2	
September	2·04	12	4·60	4·04	84·1	57·6	5·64	679·4	80·9	60·0	
October	1·28	14	5·43	4·58	79·4	51·8	5·88	677·2	83·0	60·3	
November	2·06	9	6·99	5·72	69·0	37·9	7·16	704·6	86·6	61·4	
December	3·72	11	4·86	3·88	82·2	54·1	5·79	—	81·6	61·4	
January 1955	6·77	13	5·55	4·41	85·3	46·5	7·48	—	83·5	59·8	
Sums	28·46	93	40·90	33·35	—	—	—	—	—	—	
Means	—		5·11	4·17	82·5	54·3	6·1	642·3	81·9	60·6	
February	4·46	12	4·33	3·82*	86·8	57·2	5·78	—	82·3	62·1	1955 Food Crops Season
March	3·62	10	5·77	5·64*	85·7	49·7	5·89	—	83·5	63·5	
April	6·79	16	4·81	4·32	83·9	57·6	6·44	—	82·3	62·7	
May 1955	3·72	13	5·01	4·54	81·6	60·3	7·18	—	81·4	63·1	
Sums	18·59	51	19·92	18·32	—	—	—	—	—	—	
Means	—		4·98	4·58	84·5	56·2	6·32	—	82·4	63·1	
General Sums	47·05	144	60·82	51·67	—	—	—	—	—	—	
Means	—		5·07	4·31	83·2	54·9	6·17	—	82·1	61·4	

* From 36″ non-recording evaporimeter.

TABLE 2.

COMPARISON OF 1953 AND 1954 METEOROLOGICAL DATA FOR THE MONTHS SEPTEMBER, OCTOBER AND NOVEMBER.

	Rain-fall	*Rainy Days >0·01″*	*Evapor-ation*	*Relative Humidity*		*Sunshine*		*Temperature*	
				a.m.	*p.m.*	*C.S.*	*Callender*	*Max.*	*Min.*
Sept.									
1953	7·13	10	4·26	82·0	57·8	5·9	752	81·6	60·7
1954	2·04	12	4·04	84·1	57·6	5·6	679	80.9	60·0
Oct.									
1953	5·04	18	5·21	79·3	56·7	6·3	788	82·9	62·3
1954	1·28	14	4·58	79·4	51·8	5·9	677	83·0	60·3
Nov.									
1953	6·27	16	4·29	77·1	57·0	6·7	754	83·2	62·8
1954	2·06	9	5·72	69·0	37·9	7·2	705	86·6	61·4

TABLE 3.

SEED COTTON YIELDS PER ACRE OF BP52 STRAINS AT NAMULONGE.

ACREAGES FOR MEAN YIELDS IN PARENTHESES.

Sowing Period	*1950-51*		*1951-52*		*1952-53*		*1953-54*		*1954-55*	
	First rains 23·46″		*First rains 26·65″*		*First rains 17·83″*		*First rains 14·17″*		*First rains 17·05″*	
	Yield p.a.	*Per cent. of June 1-15*	*Yield p.a.*	*Per cent. of June 1-15*	*Yield p.a.*	*Per cent. of June 1-15*	*Yield p.a.*	*Per cent. of June 1-15*	*Yield p.a.*	*Per cent. of June 1-15*
June 1-15	961 (3·0)	100	1150 (1·1)	100	920 (3·9)	100	965 (9·8)	100	380 (9·5)	100
June 16-30	—	—	1163 (5·4)	101	983 (3·2)	107	975 (8·4)	101	429 (19·3)	113
July 1-15	582 (3·8)	61	1072 (0·4)	98	1015 (3·8)	110	—	—	312 (4·0)	82
July 16-31	575 (5·4)	60	1145 (1·2)	100	679 (1·4)	74	—	—	341 (9·4)	90
Aug. 1-15	474 (3·4)	49	831 (1·7)	72	562 (7·7)	61	756 (7·0)	78	281 (2·7)	74
Aug. 16-31	—	—	772 (1·4)	67	277 (5·2)	30	—	—	161 (4·5)	42

The important difference between the years in August and September was in amount of rain. Sunshine, temperatures, evaporation, even number of rainy days did not differ to any great extent. In November, on the other hand, rainfall was less, rainy days fewer, humidities lower and evaporation higher than in 1953. In this respect the data fit in with experience in the country round about Namulonge. Rainfall recording stations within 20 miles radius of Namulonge did not record any serious shortfall until November. Thus it appears that the September-October deficiency may be ascribed to the chance of missing nearly all storms when normal second rains weather was experienced, whereas the November deficiency was the consequence of a widespread drought.

In Table 3 are given seed cotton yields of BP52 material for the past five seasons. The extremely poor returns in 1954-5 do not obscure the effects of time of planting, the August sown cotton yielding only 74%-42% of that sown in June.

Qualitative information provided by a limited number of nylon/monel metal electrical resistance units indicated that moisture was never extracted from the soil from a greater depth than that at which the roots were already tapping by mid-September. Though moisture was subsequently reduced to wilting point to this depth, the roots were seemingly unable to exploit the available moisture further down the profile.

Unfortunately in these soils nylon/monel metal units have given considerable trouble at the soldered connection to the flex and are now obsolete. A new pattern of nylon/stainless steel unit has been under test for some time and appears to be satisfactory. As the continuous ground cover and the perennial habit of grass lends itself better to a quantitative study of transpiration, these tests have been made under either *Paspalum notatum* or *Chloris gayana*. Their application to quantitative work with cotton follows this coming season.

Faulty Graduation of Rainfall Measuring Cylinders.

In June, 1954, an error was discovered in the manufacturers' graduation of the batch of measuring cylinders which have been in use at Namulonge since 1947. The cylinders were of the tapering base type and the errors are confined to the graduations on the tapering section. Errors rising from 0·01 ins. to 0·05 ins. occurred in this region. Above 0·11 ins. there was a constant positive error of 0·05 ins. The cumulative total of these errors over a year has been most serious, affecting the statistics of many of the water relations experiments previously conducted at Namulonge.

Corrected rainfall data for the period 1947-1954, during which the faulty cylinders were in use, are given in Table 4. The faulty gauges resulted in an overestimate of the annual rainfall varying between 6 and 10 inches.

TABLE 4.

CORRECTED RAINFALL DATA FOR NALUMULI (MET. STATION), 1947-54.

	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	5·17	1·17	0·20	2·94	1·39	0·61	1·48	0·89
Feb.	3·53	2·09	0·70	3·96	1·99	2·66	0·67	2·23
Mar.	4·51	3·83	2·27	6·18	7·61	4·29	2·18	3·19
Apr.	5·42	8·30	5·16	7·41	9·83	7·66	5·35	4·32
May	3·48	3·21	5·10	6·31	5·41	3·44	4·45	4·42
June	1·72	2·22	2·53	4·20	2·55	0·49	2·27	2·82
July	2·03	2·93	3·00	0·94	3·00	1·29	0·46	5·26
Aug.	3·26	2·73	3·34	2·88	3·62	1·79	3·81	4·51
Sept.	4·00	4·69	0·90	5·17	4·25	2·59	6·20	2·04
Oct.	2·50	2·65	4·00	4·94	6·70	2·62	4·22	1·28
Nov.	0·69	3·30	1·59	2·36	7·02	2·58	5·28	2·06
Dec.	2·27	0·28	3·63	3·38	6·36	0·18	5·73	3·72
Total	38·58	37·40	32·42	50·67	59·73	30·20	42·10	36·74

CROP HUSBANDRY

BY

A. N. PRENTICE.

General.

The cotton growing year was dominated by a long spell of unusually dry weather in the very heart of the main growing period, September-November. Over 85 days in this period the rainfall totalled 3·18 ins. and however drought-resistant the crop, however good the soil-moisture reserves, yields suffered. Yields of seed cotton as low as 700 pounds per acre were the best that could be produced on Namulonge this year, and in general the cotton crops were only half the size usually expected. Other second rains crops fared even worse. Maize failed altogether, and most of the beans acreage was never moist enough to plant.

The crop had little power of recovery after insect attack. Attack by *Lygus* was certainly no lighter than usual, and attack by *Helopeltis* on parts of the Station was the heaviest so far experienced and would have given a set-back to the crop even in a good growing year.

Time of Planting and Spacing.

The dry spell was prolonged enough to affect cotton of all dates of planting, although the penalty for late planting was relatively

heavier than ever. A large time-of-planting trial with BP52/NC54 cotton gives an idea of the absolute yields obtained in such a season as this as well as emphasizing that early planting is all-important in winning what yield there is to be got out of a season, good or bad. Seed cotton yields were:—

		Lb. per acre.	*As % of Early*
Early	(18th June)	529	100
Three weeks' delay	(9th July)	417	79
Six weeks' delay	(30th July)	285	54
Nine weeks' delay	(20th Aug.)	174	33

All differences were highly significant. Though Namulonge was less fortunate than neighbouring areas in the September and October rainfall, the more general November drought must have depressed the yield of the commercial cotton crop. The Buganda crop finished well below expectation this season.

In the same trial this year there were no significant differences between the four spacings used ($7\frac{1}{2}$, 10, 15 and 30 thousand plants per acre) but the closer spacings, corresponding with the Department's general advocacy, were as usual as good and safe as any. There was an indication (not reaching significance) of interaction between spacing and time-of-planting: the two wider spacings outyielded the two closer by some 30 lb. per acre at the earliest planting but thereafter fell behind to the extent of 40 lb. per acre at the latest planting. Timely planting is the master-influence on yield of cotton but if a grower has to plant late for any reason he would be wise to keep his spacing close.

There are three aspects of spacing on which data are being gathered over the seasons: yield, quality and time-of-arrival of crop. This last has some importance in Buganda, where because of the double-cropping system that is practicable by the growers, any measure which can speed up the agricultural calendar eventually makes possible more timely planting of cotton.

Development records from flowering onwards show that the flowering curve rises more steeply the closer the spacing, although total flowering is ultimately of the same order for any reasonable spacing. The bolling curves should follow their own flowering curves, but in practice here for reasons so far not explained the close spacing often loses some—not all—of its initial advantage in flowering at boll-split. Some of the potential gain in crop-arrival is realized in practice. This year, discounting a fall and rise in boll-maturation period with advancing season, with picking intervals as close as a week to give sensitivity, the two wider spacings were slightly the later, being 5% to 10% behind the closer spacings in any given week. The apparently trivial gain of a week or two is nevertheless geared to

slightly earlier planting* and harvest of the following food crops and thus in turn again to timely planting of the cotton crop—the importance of which cannot be overstressed.

Peak rates as well as total flowering were lower than usual on Namulonge this year. A peak rate of 6-7,000 flowers per acre per day for early-planted cotton is half of what might be expected in most seasons. The loss between flowering and boll-split was not unusually great with early planting but was marked with late planting: for instance in the moderately close 3 ft. × 1 ft. spacing, with the earliest planting some 27% of the total flowers were recovered as pickable bolls (compared with say 30-40% in other seasons), whereas with the latest planting the corresponding recovery was below 10%.

Good rains fell from the end of November on into early February, 1955, but cotton was unable to retrieve itself. The crop in one field was left standing until the end of March to discover whether the flush of flowers induced by these back-end rains would give a worthwhile picking, but the end result was a miserable 20 lb. per acre of seed cotton. This field had yielded normally, for the season, and after the original pickings the plants flowered well but pests and diseases, notably false codling moth bollworms, stainers (*D. nigrofasciatus*), jassids and various boll rots developed in force, and gave a considerable potential late crop no chance to mature.

Rotation Trials.

In the simple crop succession trial, preceding treatment made no difference to the yield of the NC54 cotton indicator crop this season, while time of planting gave a highly significant difference in keeping with that described above. The bearing of "fertility" on yield is completely overridden in the short run by the importance of the simple practice of timely planting. The early and late planting dates were 18th June and seven weeks later on 6th August, the latter date being set by the harvest of the maize crop.

	Seed cotton, lb. per acre.	
Following:	*Early*	*Late*
Bare fallow	616	285
Sunnhemp, cut as mulch	620	288
Maize	—	280
Legume crop	—	279

*The early planting of food crops such as maize and beans in the first rains seems to be of marked benefit to these crops also, see data from a maize yield trial in the 1953-4 report, where yields dropped progressively from 2,800 lb. to 1,450 lb. per acre as planting was delayed from 6th March to 20th April. To plant maize on the first possible rains of the year means a climatological risk, but Manning and Farbrother (1953-4 report) have shown that it is a calculable risk well worth taking by the farmer.

The food crops which preceded the cotton had themselves given fairly satisfactory yields, with the short-term K8 maize yielding just over 2,000 lb. of dry grain to the acre, and beans half of this figure. The other legume crop, groundnuts, was a near failure with a yield of little over 200 lb. of shelled nuts to the acre, due to heavy damage to the stand by cranes. The first rains were normal.

In the other trials in the rotation series the cotton yields were all low, with time-of-planting dominating all else. Cotton, following one and two years' *Chloris gayana* grass rest after an intervening bean crop, was no better than cotton after various continuous arable treatments, manuring had no effect and furrow-mulching indicated if anything a depression, but no differences had significance. The drought brought everything down to one hum-drum level of mediocrity.

Ridging.

The 4-acre trial of flat v. tie-ridged cultivation was planted on 6th July, with NC54 cotton, but the overall yield of 312 lb. seed cotton per acre was poor even in the setting of this particular season. Ridged was a significant 16% lower in yield than flat. Any explanation can only be guesswork, but the get-away after planting was rather slower on the ridge* than on the flat, and even a few days' delay in (effective) time-of-planting may have been important this season.

A side issue in this trial is perhaps worth recording. A grassed road 15 ft. wide running between the eight pairs of plots was ploughed and brought under cotton (as a weed control measure). Growth was noticeably better here than in the plots proper, and the yield was better by 100 lb. per acre, or over 20%. There was no replication, of course, but from knowledge of the land the result can be classed as probably true, indicating for once this season that new land is better than old.

Maize Work.

For the time being, maize is being grown as a farm crop in the first rains only. Second rains maize, often successful, is not being grown except in breeding plots until the status of maize stalk-borer (*Busseola sp.*?) as a pest is better understood. The breeding material grown in the second rains of 1954 was a failure owing to the September-November dry spell, but reserve seed is available and the work has merely been delayed. Namulonge is co-operating where it can usefully do so in the investigations on maize sponsored by the plant breeding sub-committee of E.A.A.F.R.O.

*In the big time-of-planting trial discussed earlier, all treatments were on the ridge, but all seed was soaked before planting, and germination was fast and good.

Miscellaneous.

"Less precise methods" than the breeding technique used for the highly-bred BP52 "are appropriate for stocks in the early stages of development" and an example of such a stock is 7/367 from the Lake Province of Tanganyika and its Albar 51 cross. These lots continue to show enough promise to merit attention from the full-time cotton breeders. Simple selection in the 7/367 range had given material which needed sorting out in the field, and two large trials, each with 31 strains, showed that several of the selections were competitors in yield with a good BP52 type on its own ground for this particular season. In the event, however, the most striking outcome was the good yield of a group of a dozen 7/367 × Albar 51 crosses (F2 seed) included in one of the trials. The twelve occupied the first twelve places out of thirty-one. The yield for the whole trial was 407 lb. seed cotton per acre—about normal for a 1st July planting, this season—but whereas the Albar crosses averaged 512 lb. the other nineteen strains averaged 342 lb., i.e. some 33% less (C of V of trial 15·3%); NC54 in this trial averaged 394 lb., the best 7/367 a non-significant 29 lb. better, and the best Albar cross a significant 249 lb. better. It is tempting to ascribe this good showing on the part of the Albar cross group to undoubtedly good resistance to bacterial blight—the *raison d'être* of the cross—but the cross was earlier in flowering, to several observations, and this in itself may have tipped the balance strongly in its favour in a season when "time of planting" in any of its aspects was the controlling factor in yield.

Soil Chemistry

BY

P. H. LE MARE.

During the year the soils laboratory was brought into full use. Most of the analysis up to now has been on soil samples from experiments at Ukiriguru, where there are long term field experiments on which to work. This will be described in the Ukiriguru report for 1954-5.

The Namulonge programme has again been largely in the field. The 2^5 exploratory experiment at Sendusu* reported last year, in which cotton was grown during the second season of 1953, was continued for observations on residual effects with maize in the first season of 1954. Two of the previous year's treatments (date of clearing

*To avoid confusion the local name Sendusu has been adopted for a part of the western section of the estate. See Review of Research Programme, 1954. The name Namulonge will in future be reserved for the estate as a whole.

of previous crop and spacing) that were unlikely to have residual effects were replaced by triple superphosphate supplying 0·5 cwt. P. per acre, and sulphate of ammonia supplying 0·5 cwt. N. per acre. The triple superphosphate was placed before planting and the sulphate of ammonia was given as a top dressing at tasselling.

The mean yield from all treatments was 3,910 lb. dry grain per acre, and the mean population 9,720 plants per acre. Table 5 gives the main effects and two factor interactions in lb. dry grain per acre.

Table 5.

Effect of residual and directly applied superphosphate and sulphate of ammonia on maize, Sendusu, 1954.

	Dry grain, lb./acre.
Mean Yield:	3,910 ±111·0
Main effects:	
Sulphate of ammonia applied in 1953 N_1	352
Sulphate of ammonia applied in 1954 N_2	323
Triple superphosphate applied in 1953 P_1	− 89
Triple superphosphate applied in 1954 P_2	− 39
Interactions:	
N_1N_2	−214
N_1P_1	239
N_1P_2	95
N_2P_1	−131
N_2P_2	− 76
P_1P_2	66
Significant effects and interactions: 5%	238
1%	330

The general level of yield was good. Phosphorus failed to increase the yield, although on the same plots in the previous season it gave an extra 130 lb. of seed cotton in the absence and 250 lb. in the presence of sulphate of ammonia. The difference between cotton and maize in their response to phosphorus shown by this experiment is interesting and will be followed up.

The residual and direct effects of sulphate of ammonia on the maize were similar. When it was applied either to the previous crop or directly to the maize, yield was increased by about 550 lb. dry grain per acre; application in both seasons increased grain yield by 675 lb. In discussing responses to sulphate of ammonia the possible effect of sulphur, as well as that of nitrogen, must be borne in mind. As yet we have no knowledge of the sulphur status of our soils. This will be investigated in field experiments in 1955.

During the second season of 1954 three experiments were put down as part of the Communal Experiment at Kirimantungo, Nalumuli and Sendusu. All experiments included triple superphosphate and sulphate of ammonia as treatments. At Kirimantungo a comparison of maize stover mulch with no mulch was made. At Sendusu two dates of planting were included as treatments and at both Nalumuli and

Sendusu there was a comparison of two populations. Details of the designs and treatments were as follows:—

	Kirimantungo	*Nalumuli*	*Sendusu*
Design:	2^3 in four blocks of eight plots each.	2^3 in four blocks of eight plots each.	2^4 in four blocks of eight plots each, the four factor interaction being confounded with blocks.
Mulch (M):	Maize stover laid in furrows.	—	—
Time of planting (T):	—	—	T_0: 17th June. T_1: 21st July.
Spacing (S):	—	S_0: 16 inches within rows, two plants per hole. S_1: 32 inches within rows, two plants per hole.	
Nitrogen (N):	None and 1·0 cwt. N per acre as sulphate of ammonia, applied in three doses, each of 0·33 cwt. N, at monthly intervals starting in mid August. The fertilizer was applied on the ridge in drills between the plants.		
Phosphorus (P):	None and 0·5 cwt. P per acre as triple superphosphate. At Nalumuli and Sendusu this was placed before planting in two bands 2 inches below and 3½ inches to the side of the seed. At Kirimantungo the seed was planted in error before the superphosphate had been applied. The superphosphate was not applied until 28th July, when it was placed on the ridge in drills between the plants.		

Planting at Nalumuli and Kirimantungo was on 2nd July and 15th June respectively. Spacing at Kirimantungo was 24 inches within the row, with two plants per hole.

The mean yields, main effects and two factor interactions are presented in Table 6.

Table 6.

Mean yield, main effects and two factor interactions in cotton experiments at Nalumuli, Kirimantungo and Sendusu, lb. seed cotton per acre.

Nalumuli		*Kirimantungo*		*Sendusu*	
Mean	396 ± 26·6	Mean	399 ± 21·9	Mean	546 ± 31·4
Main effects		Main effects		Main effects	
S	− 86	N	− 13	T	−298
N	34	P	10	S	− 90
P	37	M	43	N	− 34
				P	25
Interactions		Interactions		Interactions	
SN	− 16	NP	25	TS	36
SP	13	NM	− 37	TN	29
NP	− 5	PM	8	TP	− 11
				SN	12
				SP	− 21
				NP	− 18
Sig. effects and interactions		Sig. effects and interactions		Sig. effects and interactions	
5%	55	5%	46	5%	67
1%	75	1%	62	1%	93

Under the droughty conditions of the season, increased yield from nitrogen and phosphorus would not be expected and was not obtained. At both Nalumuli and Sendusu, the greater populations, about 18,000 plants per acre, which is rather less than generally recommended, gave 90 lb. more seed cotton than did half this number of plants. At Sendusu the July planting gave 300 lb. less seed cotton than the June planting. At Kirimantungo, mulch, in the absence of nitrogen, increased the yield by 80 lb. The higher yield level at Sendusu was associated with a higher rainfall in that area, about 3 inches more than at the other two places.

The nitrate concentration in the top 6 inches of soil was determined during the season. Table 7 gives the concentration of NO_3-N on those plots which had not received any sulphate of ammonia.

Table 7.

Soil nitrate under cotton in the absence of added nitrogen, ppm N in oven dry soil.

	Nalumuli	*Kirimantungo*	*Sendusu*
Early October	12	12	11
Early November	14	19	12
Early December	20	15	12

These figures clearly reflect the low rainfall and consequent poor crop growth. In the previous year, under similar experimental conditions, the nitrate concentration in early December was only 3 ppm N.

Plant Physiology

by

H. G. Farbrother.

Growth and Development.

Detailed records have again been taken on the growth and development of early and late planted BP52.6MB using material from the six main comparisons of the Communal Experiment.

The environment this year provided an excellent contrast—for growth analysis purposes—with the previous year. A severe mid-season drought followed the two wet cool months of July and August. 1953-4, on the other hand, began with a hot dry July but good second rains followed which persisted well into December, providing a long and protracted growing season. The basic data showing the response of the cotton crop to these two contrasting years are summarised in Fig. 2, and it will be seen that although the crop started rather better

FIG. 2. GROWTH ANALYSIS BASIC DATA

Comparison of 1953-54 with 1954-55.

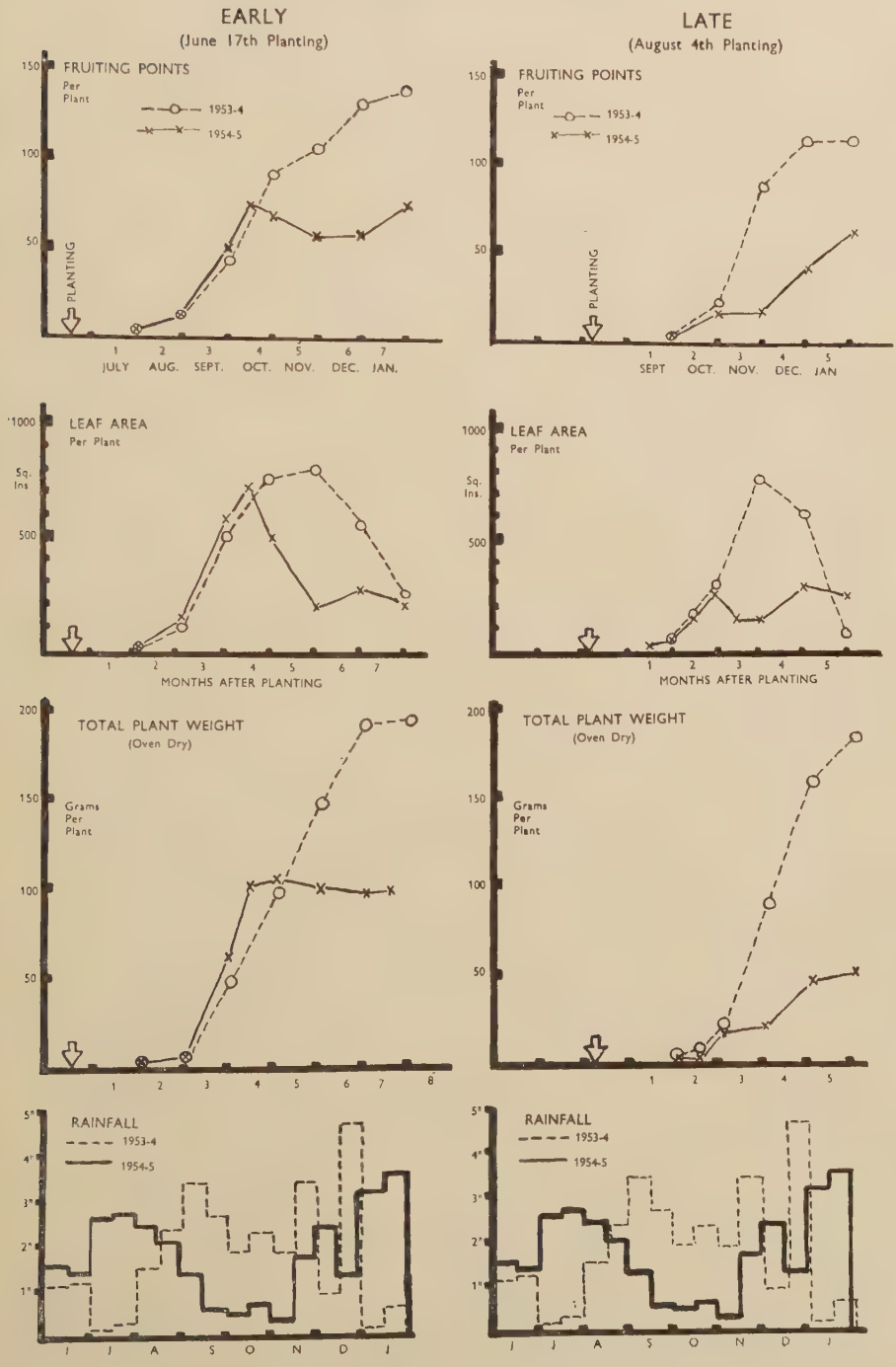
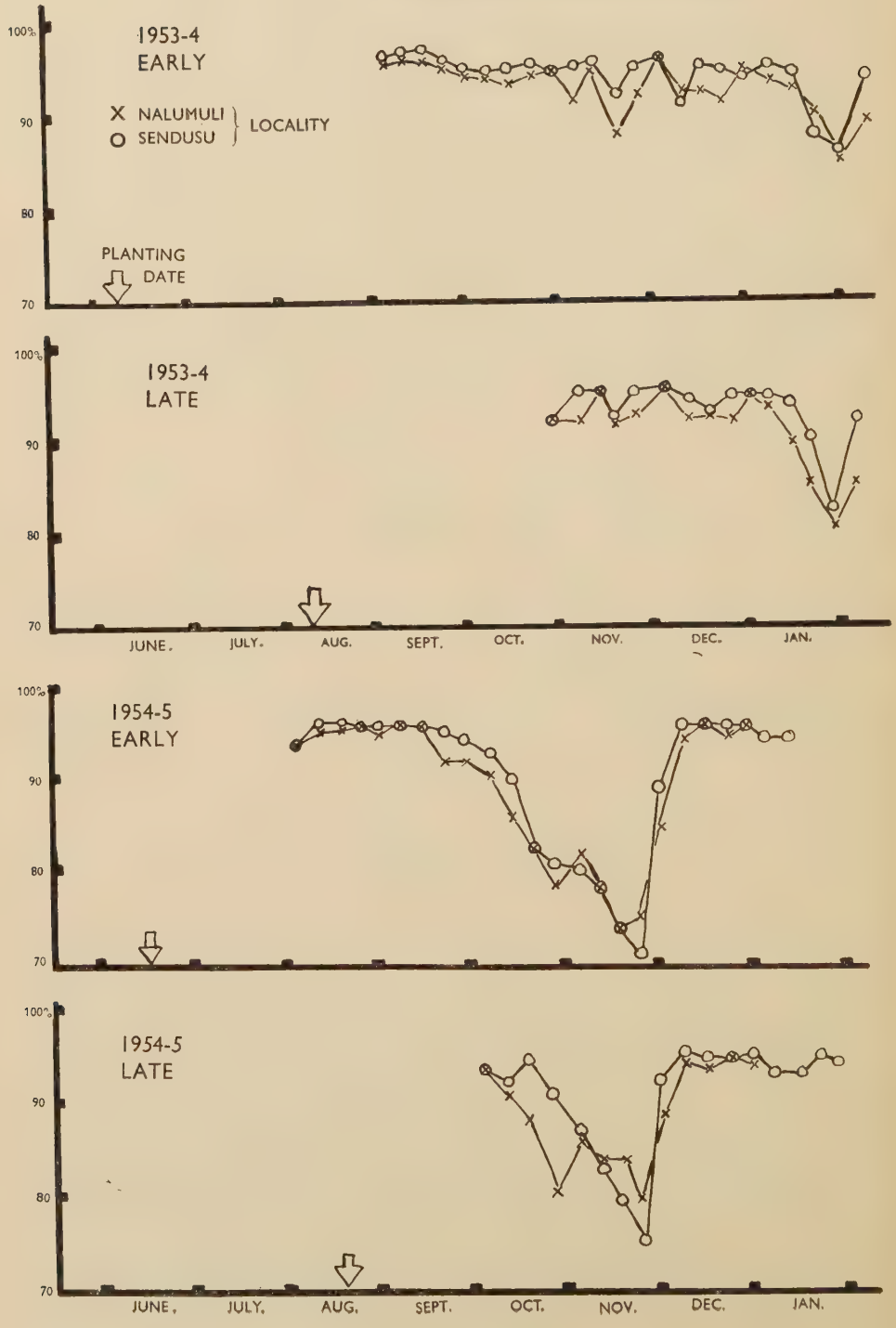


FIG. 3. **RELATIVE TURGIDITY—6.30 a.m. Values.**

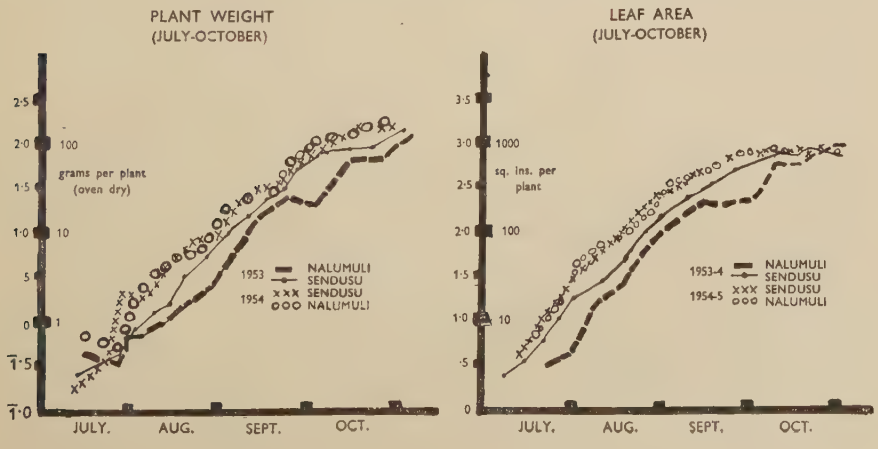


in 1954 than in 1953, it fell away badly in the mid-season drought of 1954 in all growth characters that were measured.

As the yield levels of this season fell to less than half those reported for similar dates of planting for 1950-1 to 1953-4 (See Table 3), it is of particular interest to examine the growth analysis records in further detail to determine as far as possible the cause of the failure of the crop this year. It naturally follows from the unusual rainfall distribution outlined in the Climatology Section report, that soil-plant moisture relations should be looked at first. For this purpose, early morning relative turgidity percentages give the best quantitative measure of water stress within the growing plant, integrating the effects of demand for water to meet evapotranspiration and the ability of the soil within root range of the plant to supply this moisture requirement. Fig. 3, giving relative turgidity values at 6.30 a.m. for two localities, at two times of planting for 1953-4 and 1954-5, may be taken as an index of availability of soil moisture under those conditions provided it is fair to assume that no major change occurred in the atmospheric contribution to water stress over the period of the records. That this proviso is reasonable can be verified by an examination of the open water surface evaporation figures given in Table 1, and the corresponding Table in the 1953-4 report. Taking 90 per cent relative turgidity and below as indicating conditions of water stress, it will be seen that for the early plantings, stress conditions prevailed from the first week of October, and for the late plantings from the third week of October.

As the ability of the plants to withstand the drought may have been connected with their rate of early vegetative growth, conditioned as it was by adequate moisture and low evaporation rates, this particular contrast with 1953-4 is shown in greater detail in Fig. 4,

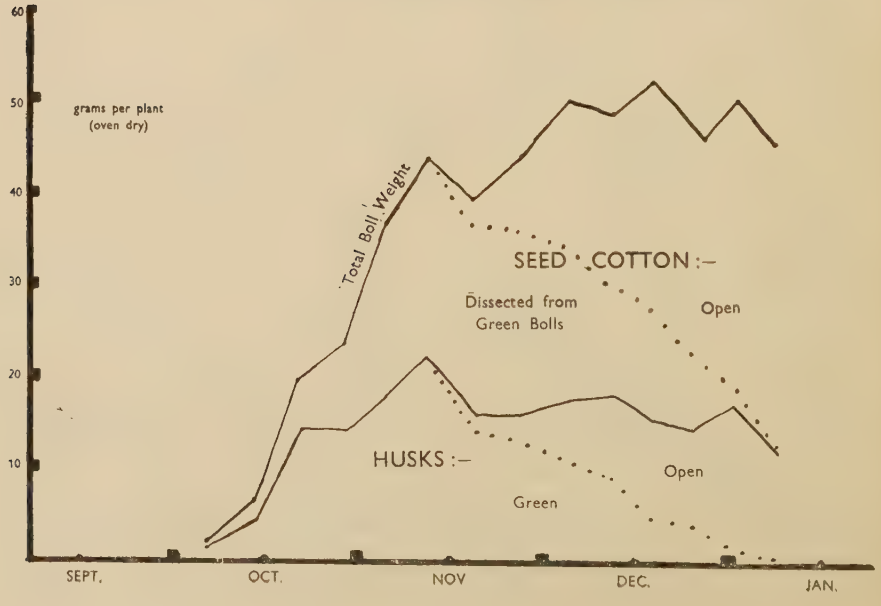
FIG. 4. GROWTH DURING VEGETATIVE DEVELOPMENT PERIOD.



in which log growth rates from July to 31st October are plotted for both localities, early planting. It will be noted that the log curves are sensibly parallel both between years and between localities. Growth in 1954-5, however, maintained a slight lead throughout this period of growth over 1953-4 in spite of the lower mean maximum temperatures prevailing (see Table 1).

Of the seasonal total of rainfall of 28·46 ins. June-January, 12·03 fell between 28th November and the end of January. Apart from the inconvenience and losses associated with such an amount of rain at time of picking, it is of interest to examine the growth analysis data to see the effect, if any, on boll development of these late rains. It is not possible to assess the effect of late rains on the late plantings, as the late cotton carried no bolls before the late rains began. Consideration must therefore be limited to the early plantings. It will have already been seen (Fig. 2) that the late rains did not increase total plant weight. Similarly total boll weight per plant remained stationary from 8th December onward. Within the boll itself, however, the amount of seed cotton dissected from green bolls and, later, the open seed cotton did increase in weight, but only at the expense of husk weight (see Fig. 5). Earlier, even the increase in total boll weight recorded between 8th October and 8th November must have been largely due to redistribution of synthesised carbohydrates already existing within the plant.

FIG. 5. BOLL DEVELOPMENT—EARLY PLANTINGS.
(30 Plants per Sample per Week).



From Fig. 5 it can be assumed that the late rains beginning 28th November contributed nothing whatever to the growth or yield of the early planted crop, although the final picking was not taken until 8th January, some 40 days later. By comparison the comparable period of the previous year saw the total boll weight per plant almost doubled —and then not at the expense of total plant weight. As will be seen from Fig. 2 there was certainly no suggestion of high growth rates in the new flush that followed the rains.

Debudded plants continued to develop their fruiting structure through the dry spell, but at a slower rate than in the previous season. "Matchhead" bud shedding accounted for approximately 50% of these fruiting points. A surprising feature of the behaviour of debudded plants was that, for the period recorded from 9th November to 15th December, the relative turgidity values followed those of the control plants exactly.

Lint Physiology

BY

J. P. EVENSON.

Fibre and Spinning Tests on 1953-54 Experiments.

Unlike the 1952-53 season, no extreme change in fibre characters was recorded, in fact over the range of material sent for spinning test from Namulonge the spinning quality of the cotton was good and the count × strength products higher than usual. The fibre and spinning test data for lint from successive weekly flowerings of one strain early and late planted in the same locality are given in Table 8. Differences between early and late planted groups as a whole are apparently of small account for most characters, but there were quite considerable variations in the yarn appearance of the various flowering date groupings, and it may be that these are partly related to the variation in chalazal maturity. In future the chalazal maturity of all picks will be determined.

From all pickings the damaged bolls were separated and ginned separately, even if they contained some lint and seed that was apparently undamaged. From the early planting at Nalumuli the apparently good seed cotton that came from bolls with one or more locs damaged was separated out, ginned and sent for spinning test, and the results are shown in Table 8. There are signs that the yarn appearance was affected, and indeed pH tests on the 1954-55 crop showed that apparently good lint from damaged bolls was highly alkaline, indicating that it had suffered some deterioration as a result of damage by fungi. (Marsh & others, 1).

Table 8.

Effect of flowering date on hair characters and spinning quality in two plots of cotton (Shirley Institute tests) 1953-54.

Flowering date	*E.L. (32nds)*	*Maturity ratio*	*Fibre wt. per cm.*		*Corrected lea count × strength product*	*Yarn appce.*
			Mean	*Standard*		
Early planted						
19th Sept.-2nd Oct.	42	0·875	149	170	—	—
4th-9th Oct.	44	0·83	146	176	2242	4
21st-30th Oct.	43	0·845	147	174	2163	4
1st-13th Nov.	43	0·815	139	171	2292	3
14th-26th Nov.	43	0·81	139	172	2417	3
27th Nov.-8th Dec.	41	0·795	131	165	—	—
Late planted						
2nd-13th Nov.	43	0·85	146	172	2324	2
14th-21st Nov.	43	0·825	143	173	2295	3
27th Nov.-7th Dec.	42	0·78	137	176	2433	4
8th-18th Dec.	40	0·755	131	173	2412	5
19th Dec.-2nd Jan.	40	0·825	143	173	2292	4
Good lint from damaged bolls of early cotton	43	0·835	141	169	2141	5

Yarn appearance classification:—1—Very good. 2—Good. 3—Fairly good 4—Fair. 5—Moderate. 6—Poor. 7—Very poor.

Neppiness.

Calculations of the relation between chalazal damage percent and subsequent yarn appearance have led to the conclusion that any strain with more than 20% chalazal damage is likely to have its yarn appearance spoiled by the appearance of seed coat nep.

The air flow machine (Evenson, 2) has been more fully developed and calibrated during the year, and estimates of air flow through standard plugs of chalazal (Ch) and remainder (Rm) lint from seed cotton samples from the breeding stocks have been carried out as a routine. It has been demonstrated that the heritability of the character Rm-Ch is fairly high. In nineteen strain groups in which Rm-Ch data exist for the parent bulks, the correlation between the values of the bulks and of their progenies gave $R^2 = 0{\cdot}61$. It should therefore be possible to select strains with a low Rm-Ch value with a fairly high value of Rm.

The mean airflow characteristics of the various types tested are given below:—

	Rm	*Ch*	*Rm-Ch*
BP52 selections	5·7	4·4	1·3
Albar selections	6·2	5·4	0·8
MU8 × BP52² selections	5·2	3·7	1·5

These values are of interest because of the spinning behaviour of these three groups. The BP52 selections have over the past few years given very good yarn appearances and yarn strength on spinning. The spinning behaviour of the MU8 × BP52²'s has however rarely been as good as their fibre characters would have suggested, and this may in part be accounted for by the fairly large value of Rm-Ch coupled with the generally lower level of both Rm and Ch (an air flow value of 3·7 is equivalent in a cotton of this fineness to a maturity ratio of 0·55). The Albar selections are on the whole rather coarser cottons than the other two groups and this accounts for the slightly higher over-all value of Rm and Ch. However the reduced value for Rm-Ch is of interest, and may be expected to contribute to good yarn appearance.

A sample of S47 lint which had been divided into the two parts, (a) lint attached to the chalazal cap (b) lint attached to rest of the seed, was tested at the Shirley Institute and gave the following fibre test results:—

	Chalazal	*Remainder*
Maturity Ratio	0·47	0·685
Fibre weight per cm.	83	115
Standard fibre weight	177	168

The difference in intrinsic fineness between chalazal lint and the rest was small, but there was a very large difference in maturity ratio and fibre weight per cm.

Quality Testing.

As a result of the development of studies on cotton quality in relation to botanical factors it has become necessary to institute a certain amount of cotton testing work. Simple tests have been developed that are not only of value to the physiological work of the section but are also useful to the plant breeders, as they enable them to include an assessment of quality in their measurement of plant characters right from the single plant stage. In the four months up till April 1955 some 120 full tests and some 80 partial tests were completed, on seed cotton from Namulonge (Uganda), Tanganyika, Nyasaland and Kenya. The nature of the tests in use is indicated below. Details will be given elsewhere.

1. *Seed coat nep test.* Counts of roller ginned seed are made to determine chalazal damage percent (Evenson, 3). Damage rates below 15% are classed as satisfactory. Adequate evidence exists, as a result of three years' experience, to show that the chalazal damage rate can be reduced rapidly by selection without causing any great change in the plant and seed cotton characters.

2. *Airflow test.* This machine, which works on the same principle as the Micronaire, is used to determine the relative maturity of the chalazal lint (Ch) and the remainder (Rm) in order to select strains with a high maturity value for Rm and a small value for Rm-Ch (Evenson, 2).

3. *Modified sorter test.* This technique gives information on the proneness of the longer hairs to break. Over the small range of staples dealt with at Namulonge, a significant correlation exists between % short and broken fibre and the lea count × strength product at 40's.

Prior to the introduction of these tests the plant breeder had to leave the assessment of spinning quality until he had enough lint for a small scale spinning test. It is hoped that they will make possible a greater concentration of effort from the single plant stage on the strains most likely to spin well. The techniques are simple, but sufficiently accurate to provide information where none existed before.

Entomology

BY

T. H. COAKER.

Studies of Crop Loss.

The study of crop loss was carried out in the same way as last year, using single row plots treated with insecticides. The number of spray periods was reduced to three and these treatments together with controls were applied to both early and late sown cotton in the Communal Experiment as follows:

Coverage.		*Early sown.*		*Late sown.*
Complete season	a	Aug.-Jan.	e	Oct.-Feb.
Bulk of *Lygus* attack	b	Aug.-mid Oct.	f	Oct.
Bulk of bollworm attack	c	Mid Sept.-Jan.	g	Mid Oct.-Feb.
Control	d	Control	h	Control

The spray formulation was changed to a mixture of DDT and toxaphene in equal proportions, applied once every 5 days as a 0·2% solution to run-off. Toxaphene was included in the spray, as better repellance of *Lygus* spp. is obtained than from DDT alone.

TABLE 9.

ANALYSIS OF SHEDS ON EARLY SOWN COTTON.

Locality	Treatment	Bollworms				Bug Punctures				Disease				Nil Sheds				Uncertains				Total
		Buds	Bolls	Total	%	Buds	Bolls	Total	%	Buds	Bolls	Total	%	Buds	Bolls	Total	%	Buds	Bolls	Total	%	
Sendusu	a	14	19	33	1·6	2	202	204	10·1	4	33	37	1·8	207	1507	1714	85·1	6	18	24	1·2	2012
	b	6	19	25	1·0	2	280	282	11·6	5	41	46	1·9	267	1785	2052	84·5	1	22	23	·9	2428
	c	13	14	27	1·5	6	205	211	1·1	0	13	13	·7	209	1335	1544	85·9	0	2	2	·1	1797
	d (Control)	211	223	434	17·7	17	457	474	19·4	23	40	63	2·6	246	1216	1462	59·9	3	4	7	·3	2440
Kirimantungo	a	8	36	44	2·4	9	427	436	23·4	9	38	47	2·5	133	1177	1310	70·3	0	25	25	1·3	1862
	b	5	21	26	1·3	3	580	583	28·6	5	32	37	1·8	174	1196	1370	67·1	5	19	24	1·2	2040
	c	20	26	46	2·2	8	521	529	25·4	15	44	59	2·8	183	1250	1433	68·6	1	18	19	·9	2086
	d (Control)	173	150	323	22·6	14	484	498	34·8	10	16	26	1·8	117	460	577	40·3	0	6	6	·4	1430
Nalumuli	a	8	13	21	·9	10	362	372	17·5	2	15	17	·8	197	1463	1660	78·2	18	34	52	2 4	2122
	b	4	37	41	1·8	3	266	369	15·9	3	21	24	1·0	214	1631	1845	79·2	17	31	48	2 1	2327
	c	6	5	11	·6	9	276	285	14·8	5	13	18	·9	170	1424	1594	83·0	6	5	11	5	1919
	d (Control)	120	121	241	10·8	16	592	608	27·2	10	16	26	1·2	232	1095	1327	59·5	15	12	27	1·2	2229

TABLE 10.

ANALYSIS OF SHEDS ON LATE SOWN COTTON.

Locality	Treatment	Bollworms				Bug Punctures				Disease				Nil Sheds				Uncertains				Total
		Buds	Bolls	Total	%	Buds	Bolls	Total	%	Buds	Bolls	Total	%	Buds	Bolls	Total	%	Buds	Bolls	Total	%	
Sendusu	e	10	9	19	2·4	2	109	111	14·4	0	0	0	0	137	503	640	83·1	0	0	0	0	770
	f	75	25	100	10·8	0	232	232	25·1	2	1	3	·3	135	454	589	63·7	0	0	0	0	924
	g	16	11	27	3·5	0	145	145	18·5	1	0	1	·1	117	492	609	77·8	0	0	0	0	782
	h (Control)	298	126	424	37·3	9	252	261	22·9	0	2	2	·2	116	333	449	39·5	0	0	0	0	1136
Kirimantungo	e	1	2	3	·5	0	84	84	15·0	0	0	0	0	113	356	469	83·8	3	0	3	·5	559
	f	43	15	58	8·3	0	170	170	24·4	0	0	0	0	143	323	466	66·9	2	0	2	·3	696
	g	4	0	4	·8	0	98	98	6·6	0	1	1	·2	100	323	423	80·4	0	0	0	0	526
	h (Control)	125	59	184	29·0	12	179	191	30·2	0	2	2	·3	78	177	255	40·3	0	0	0	0	632
Nalumuli	e	6	4	10	1·7	0	49	49	8·7	0	0	0	0	87	414	501	89·4	0	0	0	0	560
	f	13	9	22	3·5	0	115	115	18·3	0	0	0	0	89	401	490	78·1	0	0	0	0	627
	g	0	2	2	·4	0	41	41	7·4	0	0	0	0	97	412	509	92·2	0	0	0	0	552
	h (Control)	85	18	103	18·0	5	114	119	20·8	0	0	0	0	89	260	349	61·1	0	0	0	0	571

Lygus population fluctuations were measured by leaf damage. A comparison was made between sampling the top four fully opened leaves on the main stem for leaf grade (i.e. *Lygus* damage) and sampling the top two only. The latter method has the advantage of being more sensitive to *Lygus* fluctuations, since with one leaf added approximately every ten days during the growing period of the plant, the same leaves are not often examined twice. In addition, a larger sample can be taken. The best treatment reduced the leaf damage grade on early cotton to 18-27% of the controls (c.f. 36-57% in 1954). The peak of the *Lygus* population occurred in September, falling off on late sown cotton by the end of December.

All shed buds and bolls were collected from the experimental plots and examined for the cause of shedding. Results are shown in Tables 9 and 10.

Nil sheds (i.e. with no insect or disease damage) constituted the largest part of the sheds examined, and among nil sheds, shed bolls formed the bulk of the total. It is noticeable on both early and late sown cotton that total sheds in all localities and treatments were nearly equal, the nil sheds balancing the insect sheds, so that when the insect sheds were low the nil sheds were high and vice versa. Evidently some overriding factor was present controlling the balance of yield and overshadowing losses caused by pests.

There was little difference in the amount of sheds caused by the two types of pests on the control plots, but the insecticidal control was more effective on the bollworms. However, there was a considerable difference between the numbers of sheds per plant recorded here and those recorded by the physiologist, derived from fruiting point counts —(11 : 60 respectively). In the entomological work no attempt was made to collect the very small buds that were shed. Indeed, to do so would have been impossible. Farbrother (4) has shown that such sheds ("matchhead shedding") may be an important part of the whole, and it is therefore likely that much of the discrepancy between counts of fruiting point loss and counts of sheds recovered is due to this class of shedding. *Lygus* is one of the causes of shedding of very small buds, and to the extent that insect attack contributed to the unanalysed shedding, the picture of insect damage given in Tables 9 and 10 is incomplete.

All split bolls were picked and sorted into good, partially damaged and rotten locules. Data for this analysis are given in Table 11. Locules damaged by disease were not further considered. Those damaged by insects were divided into two classes, locules showing bollworm damage and locules showing damage consequent on bug punctures. Data are given in Table 12.

TABLE 11.

ANALYSIS BY LOCULES OF SPLIT BOLLS ON EARLY AND LATE SOWN COTTON.

Locality	Treatment	Early						Treatment	Late					
		Clean		Partially damaged		Rubbish			Clean		Partially damaged		Rubbish	
		Number	Percentage	Number	Percentage	Number	Percentage		Number	Percentage	Number	Percentage	Number	Percentage
Sendusu	a	6792	92·6	313	4·3	227	3·1	e	3795	87·8	424	10·0	89	2·2
	b	7593	92·4	394	4·8	226	2·8	f	1721	57·8	840	28·3	412	13·9
	c	6583	95·0	223	3·2	109	1·7	g	3431	86·7	384	9·7	139	3·6
	d (Control)	6205	80·5	934	12·1	572	7·4	h	1764	58·6	842	28·0	401	13·4
Kirimantungo	a	5271	87·9	425	7·1	300	5·0	e	2294	81·9	418	14·9	86	3·1
	b	5235	88·5	428	7·2	249	4·3	f	1677	68·6	587	24·0	180	7·4
	c	5862	86·4	431	6·4	485	7·2	g	1984	88·2	176	7·8	88	3·9
	d (Control)	3304	72·7	835	18·1	398	8·8	h	1096	83·7	445	25·8	178	10·4
Nalumuli	a	5986	94·4	210	3·3	139	2·3	e	1849	79·2	314	13·5	169	7·3
	b	5967	92·4	307	4·8	182	2·8	f	1972	72·7	534	19·7	204	7·6
	c	5254	95·9	152	2·3	114	1·8	g	2003	77·0	400	15·4	198	7·6
	d (Control)	4863	80·6	702	11·6	484	4·8	h	1832	66·8	569	20·9	338	12·3

TABLE 12.

LOCULE DAMAGE CAUSED BY BOLLWORMS AND SUCKING BUGS (*Heteroptera*).

Locality	Treatment	Early								Treatment	Late							
		Partially Damaged				Rubbish					Partially Damaged				Rubbish			
		Bollworms		Bug punctures		Bollworms		Bug punctures			Bollworms		Bug punctures		Bollworms		Bug punctures	
		No.	%	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	No.	%
Sendusu	a	94	30·0	148	47·2	83	36·5	77	33·9	e	85	20·0	325	76·6	24	26·9	57	64·0
	b	103	26·1	192	48·7	86	38·0	73	32·3	f	488	58·0	323	38·4	311	75·4	93	22·6
	c	44	19·7	95	42·6	31	28·4	37	33·9	g	63	16·4	312	81·2	45	32·3	91	65·4
	d (Control)	624	66·8	188	20·1	410	71·6	84	14·7	h	525	62·3	305	36·2	295	73·5	99	24·7
Kirimantungo	a	138	32·4	213	50·1	99	33·0	90	30·0	e	27	6·5	331	79·1	11	12·7	72	83·7
	b	184	42·9	185	43·2	120	48·1	73	29·3	f	176	29·9	364	62·0	119	66·1	49	27·2
	c	103	37·8	193	44·7	201	41·4	154	31·7	g	25	14·2	115	65·3	18	20·4	52	59·0
	d (Control)	456	54·6	319	38·2	246	61·8	126	31·6	h	204	45·8	227	51·0	137	76·9	38	21·3
Nalumuli	a	71	33·8	64	30·4	55	39·7	26	18·7	e	16	5·1	281	89·4	12	7·1	140	82·8
	b	115	37·4	94	30·6	109	59·8	30	16·4	f	172	32·2	308	57·6	88	43·1	97	47·5
	c	39	25·6	68	44·7	36	31·5	5	4·4	g	34	8·5	286	71·5	27	13·6	118	59·5
	d (Control)	491	69·9	146	20·7	315	65·1	103	21·2	h	177	31·1	340	59·7	136	40·2	172	50·8

External boll lesions caused by sucking bugs can be classified into a number of groups, the difference in the character of the lesion being attributed either to different bug species or to differences in the type of damage caused by the same bug to bolls of different ages. More locules were damaged by bug punctures on the late cotton than on the early cotton. *Lygus* spp. cannot be considered as constituting the largest part of the population, as the leaf grade had fallen to only one-third of that recorded on early cotton. Also the leaf grade had dropped to a very low level before the majority of the bolls which formed the crop had been set.

The locality effect on yield was predominant, with no particular treatment proving best. At Sendusu, where the difference between treatments was lowest on early cotton, recovery from insect attack occurred, shown by the late setting of the crop on the untreated plots. Recovery can only occur when moisture conditions are favourable and at Sendusu there was evidence that more water was available for growth of the early planted plots than at the other localities. There were no great differences between the insect populations at the three localities, and the largest increases from insecticidal treatments were obtained where moisture conditions were unfavourable for plant recovery. Data illustrating the relation between rainfall from October to December and response to insect control are given in Table 13.

Heliothis armigera Investigations.

Observations were made throughout the season on the principal crops for both eggs and larvae of *H. armigera.* On cotton alone, numbers of other bollworms present were also recorded.

On maize grown on the first rains oviposition commenced before tasselling but did not reach maximum numbers until 95% of the plants were flowering, when eggs were found at the rate of 8,000 per acre. Oviposition rapidly fell when the silks died, the oviposition period covering two months. Larval numbers reached a maximum of 4,000 per acre.

A succession of sunflower extending from harvest of the maize until the end of the flowering peak of early sown cotton was sampled. On the immediate crop following maize a larval population at the rate of 30,000 per acre was present, in some cases up to 19 larvae per head. A population of this density was unusual, as following successions only harboured half the amount. Oviposition commences on sunflower when the small flower bud appears, the eggs being laid on the surrounding bracts and leaves. *H. armigera* larvae cause little or no loss to sunflower yields as the majority of the larvae are found feeding on the pithy receptacle. Sunflower had no greater attraction to

Table 13.

Relationship between Response to Insect Control and Rainfall of the Last 4 Months of 1954.

	Early			*Late*			*Rainfall in inches*				*Total*
Locality	*Treatment*	*Yield lb./acre*	*% difference from control*	*Treatment*	*Yield lb./acre*	*% difference from control*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	
Sendusu	a	516	−13·7	e	316	49·7	2·49	2·08	2·78	5·60	12·95
	b	591	− 1·2	f	189	−10·4					
	c	528	−11·7	g	305	44·5					
	d	598		h	211						
Kirimantungo	a	432	27·4	e	211	52·9	2·10	1·21	2·71	4·71	10·73
	b	437	28·9	f	196	42·0					
	c	537	58·4	g	174	26·1					
	d	339		h	138						
Nalumuli	a	477	0·2	e	167	3·1	2·04	1·28	2·06	3·72	9·1
	b	494	3·8	f	182	12·3					
	c	513	7·7	g	160	1·2					
	d	476		h	162						

ovipositing moths than cotton lying adjacent. Eggs were found on cotton three weeks before flowering commenced, reaching a peak at maximum flowering in October. On cotton a few hundred yards away from the sunflower a higher population was recorded, but only 9,000 per acre compared with 7,000 on cotton adjacent to the sunflower. The *H. armigera* population on cotton rapidly increased over the first month from the commencement of oviposition and then increased gradually until maximum flowering.

Records were taken of damage caused to buds and open bolls by bollworms, with a view to relating damage to the populations present. The results are shown below.

	No. larvae per acre	
Bollworm Damage.	*9,000*	*7,000*
% buds shed	48·6	36·3
No. buds shed per plant	8·8	5·1
% locules partially damaged	7·6	9·6
% locules destroyed	13·9	9·6

The parasitism rate was about 10%. This would not be sufficient alone to restrict a potentially increasing population. However, diseased larvae were found in the field, from which a nuclear polyhedral virus has been identified. It is therefore probable that the virus enforces a restricted biological control when the conditions are favourable.

No definite resting or diapause phase occurs amongst *H. armigera* pupae, although fluctuations between 14 and 37 days are found with no predominant seasonal influence. Larvae fed on various diets showed no signs of an increase in the length of the life history outside the control fluctuations.

Apart from *H. armigera, Earias spp.* and *Argyroploce leucotreta* were present on the cotton, comprising the total bollworm population in the following percentages respectively: 70, 28 and 2. The bollworms were not present in these proportions at any one time in the season, the various species being represented at different periods of the plants' development.

Plant Pathology

BY

G. M. WICKENS AND C. LOGAN.

Bacterial Blight (*Xanthomonas malvacearum*).

This season was remarkable for the low incidence of all phases of the disease. This abnormal circumstance appeared to be associated with rather low temperatures early in the season, and lack of driving

rainstorms and high winds as the season progressed. The growing season was very dry and the average yield was low. Failure of the disease to take its normal course spoilt a number of early planted experiments. Particularly, in an experiment on the effects of seed dressing on the incidence of bacterial blight and its effect on yield, no natural infection occurred. Seed inoculated with a pure culture of *X. malvacearum* gave no diseased seedlings, and later field inoculations by leaf sprayings and stem inoculations failed to produce an epidemic in the crop. Final yield statistics indicated that any disease which may have been induced had no significant effect. Again owing to the unfavourable environment, needle prick inoculations of branches with *X. malvacearum* in an investigation of possible vascular infection of bolls resulted in no spread of the bacterium within the tissues.

To investigate the reaction of boll wall tissue and developing lint, bolls of three strains, Albar 49, Bar 7/8, and SUS 7/2, were inoculated internally at various ages. Though little bacterial boll disease appeared, other organisms developed strongly. Species of *Fusarium, Aspergillus, Nigrospora* and *Alternaria* were prevalent and these fungi were also found quite commonly in damaged seed cotton. The economic significance of these organisms remains to be determined.

The Reaction of Nigerian and Nyasaland Strains to Bacterial Blight. —500 seeds of each of 8 Nigerian strains together with similar lots of 4 Nyasaland strains and 4 local standard strains were acid treated, thoroughly washed, and then inoculated with a suspension of *X. malvacearum* by the standard method. The 16 strains were planted on 13th August in a balanced lattice design with five replications. As the season progressed, the relative susceptibility to all phases of bacterial blight was determined. Until the plants were nine weeks old, counts were made of plants showing primary infection in the form of water-soaked lesions on cotyledons and on leaves, and of lesions on the main stem. At 9 weeks old the upper leaves on the plants were subjected to leaf-spray inoculation, and at 10 weeks old they were needle prick inoculated by the standard method in the topmost available internode. On six occasions, over a period of nine days, all faded flowers in three replications were taken and inoculated at corolla drop by the atomiser method. Approximately 600 bolls were inoculated on each occasion. The results of observations made on all phases of the disease are given in Table 14 and from these the following conclusions have been drawn.

1. Germination was generally good, the Nigerian strains surpassing all others, ranging from 80-90% of seeds sown, at 7 days. The Nyasaland strains were the poorest with the local strains intermediate.

TABLE 14.

VARIETAL REACTION TO THE DIFFERENT PHASES OF BACTERIAL BLIGHT.

	Strain	Germination	Seed Inoculation			Leaf-spray Inoculation	Boll Inoculation	Stem Inoculation
		1 Week	2 Weeks	4 Weeks		12 Weeks	20 Weeks	22 Weeks
		% Seed Sown	% Infected Cotyledons	% A.L.S.	% M.S.L.	Mean Grade (Grade 1-6)	Mean Grade (Grade 0-3)	Mean Grade (Grade 0-5)
Nigerian	26C/49160-23BCP	90·0	1·56	11·10	1·40	3·0	1·21	1·25
	26C/479-25BCP	90·2	0·89	10·92	1·62	4·4	2·33	1·82
	26C/479-25-44	86·8	2·58	13·29	1·40	3·0	2·15	1·53
	26C/479-25-97	87·6	1·10	9·42	0·77	4·4	2·17	1·76
	26I/25	88·6	1·94	50·40	4·00	4·6	1·06	1·72
	26C/49197BCP	90·6	15·16	55·22	6·47	3·2	1·35	1·70
	26C/49130-21	80·2	21·92	68·62	5·53	4·4	1·96	2·03
	26C/Pure Stock	85·8	36·11	63·20	9·06	3·8	1·44	1·61
Nyasaland	CL20 Bulk	67·2	1·49	39·20	1·81	3·4	2·28	1·66
	CL20 Filter Bulk	68·0	1·48	43·98	1·99	3·0	2·35	1·70
	CLB Filter Bulk	45·4	6·26	69·68	4·69	5·0	2·53	2·58
	CLB Ngabu	45·8	13·23	76·14	5·19	5·4	2·69	2·62
"Local"	Albar 49	77·8	0·31	22·14	3·23	1·0	0·97	0·37
	Bar 7/8	79·8	0·54	13·33	1·64	2·8	2·22	1·55
	SUS 7/2	70·0	0·00	41·56	2·61	3·8	2·22	2·05
	BP52/S9	73·4	4·12	65·42	4·22	3·4	2·54	2·15
	Mean					3·66	1·97	1·75
	Standard Error					± 0·95**	± 0·16**	± 0·46**
	L.S.D. (5%)					1·18	0·45	0·58
	Coeff. of Variation					25·7%	13·7%	26·3%

**Varieties significantly different at 1%.

%A.L.S. = % of plants with angular leaf spot.

%M.S.L. = % of plants with main stem lesions.

2. Of the 16 strains the two CLB strains from Nyasaland proved highly susceptible to all phases of the disease.
3. Of the Nigerian strains, 26C/49130-21 proved susceptible to all phases of attack and so did 26C Pure Stock, but less markedly. 26C/49197 BCP and 26I/25 were also susceptible in the early stages but appeared to have boll resistance. This may be illusory for reasons given later. The three strains of the 26C/479-25 group showed marked resistance in the early stages of growth, but appeared to have no boll resistance. In this they behaved rather like BAR 7/8. One strain only showed evidence of resistance all through, namely 26C/49160-23 BCP.

These results must be treated with reserve, as the trial suffered a number of vicissitudes, especially affecting accurate assessment of reaction to stem and boll inoculation. Of these, two are controllable. It seems very clear that raw seed is to be preferred for tests of susceptibility to primary seed-borne infection, as acid treatment causes modification of the seed coat and there may be differential effects between the strains, either inherent or through variations in degree of treatment. (N.B.—the nil figure for water-soaked lesions on the cotyledons of SUS 7/2 b_2 b_3). The second lay in quantities of seed being inadequate for the laying down of separate experiments for the testing of reaction to the various phases. The populations remaining available for examination of stem tissue and boll resistance in plantings from inoculated seed may well be too small for accurate statistical assessment and probably not representative. Possibly, for example, the apparent boll resistance of 26C/49197 BCP and 26I/25 may have arisen from the elimination of a high proportion of susceptibles from the original possibly heterogeneous populations.

This season, it has again been confirmed that the susceptible (b_2 b_3) and resistant (B_2 B_3) forms of Domains Sakel are generally more susceptible than the corresponding susceptible (b_2 b_3) and resistant (B_2 B_3) forms of Upland, while the highly resistant (B_2 B_{6m}) Domains Sakel has again been found to have very high resistance surpassing that of Albar 49.

A report (Leben and Arny, 5) suggesting considerable possibilities in simple water soaking of seed as a means of eliminating seed-borne disease has led to renewed interest in Boughey's observation (6) of the effectiveness of water soaking as a method of treating seed against *X. malvacearum*. The use of antibiotics, especially streptomycin, has now also distinct possibilities. Experiments along those lines in the glasshouse have given useful preliminary results. Field experiments failed owing to lack of rain. It is proposed to continue studies along these lines.

Verticillium Wilt (*Verticillium dahliae*).

In a series of experiments employing the strains V135 (very highly resistant), B181 (resistant), and U4/8161 (susceptible), the effect of variations of the following on subsequent disease development was studied: (a) age of plant at time of inoculation, (b) method of inoculating, (c) type of inoculum, and (d) placement of inoculum. The experiments were designed partly to seek improvements of method in the large scale inoculations required in breeding for resistance, and partly to provide material for study of movement of the fungus and development of disease in resistant and susceptible host strains. Various methods of recording disease reaction were also employed and compared. Following are the main results:

1. Sharper and more distinct peaks of disease reaction, with less overlapping between the three strains, were obtained in plants inoculated at 6 weeks or older than in plants inoculated at less than 6 weeks, so that relative inherent resistance or susceptibility could be more certainly judged. Moreover, in V135 and B181 inoculated at 4 weeks (2-3 leaves expanded), unexpectedly severe disease was induced. This has not been observed to occur naturally, presumably because, with natural infection, the fungus would not by this time have reached the base of the stem. It appears that the stem of these strains has appreciably less resistance at 4 weeks than at 6 weeks. Reduction of insect damage (especially by *Lygus* and *Helopeltis*), by repeated spraying with DDT suspension, led to markedly more uniform disease reaction within strains.

2. The standard method of inoculation, by introduction of inoculum into a longitudinal deep knife slit at the base of the stem, gave rather more severe infection and greater uniformity than introduction by sewing-machine needle.

3. A homogeneous mucilage-like inoculum, prepared by high speed blending of agar cultures, was as effective as pieces of culture taken from agar plates.

4. Incidence of disease was less severe and more variable within strains by placement of inoculum in either the middle or topmost internode of the stem than by the standard method of placement at the base of the stem.

5. An eye estimate of the proportion of the plant showing wilt symptoms was quicker than, and just as effective a method of recording disease reaction as a count of the number of main stem leaves free of wilt symptoms above the topmost main stem leaf showing wilt symptoms.

6. Further observations strongly support the view put forward previously in explanation of experimental results at Barberton, that wilt diseased leaves may be an important means of carry-over of fungal inoculum from one season to the next. This line of work will be further investigated next season in conjunction with a study of movement of the fungus within the plant.

In a search for further sources of resistance to *Verticillium* wilt, the disease reaction of three exotic strains, Ishan, Tanguis AM9, and Tanguis AM10, was compared with that of V135, B181, and U4/8161. Their behaviour was rather similar to that of V135. Severe disease was induced in plants inoculated when 4 weeks old. However, plants 6 weeks old or older of the Tanguis strains exhibited a very high resistance comparable with that of V135, and the resistance in older plants of the Ishan strain was between that of V135 and B181.

Other Diseases.

Damping-off of Seedlings (*Rhizoctonia solani*).—Damping-off of seedlings this season was a nuisance but not devastating, the biggest loss recorded being 8% of seed sown, in early plantings. Experiments suggested that seed dressing with an organic mercurial dust (R1489 × 32) did not effectively control the disease.

Black Boll-wall Rot.—A rapid and destructive black boll-wall rot was observed this season and was estimated to cause a loss of about 6% of bolls in some late plantings. Although previously observed, damage had been insignificant. It appears to be consistently associated with a *Fusarium sp.*, but the primary cause has not yet been established.

Virus Disease of Sunflower.—In early plantings of sunflower this disease occasioned some concern as field symptoms agreed rather closely with those of a virus disease reported from the Argentine, which was there alleged to be transmissible to cotton. In late plantings the disease was very much less severe. Attempts hitherto to transmit by mechanical means have all failed and anxiety concerning this disease is now relieved.

Plant Breeding

BY

R. C. FAULKNER.

BP52 Modal Bulk.

During the past season 7MB was grown. Two hundred plants were chosen in the field, and selection within the range plus or minus one standard deviation was carried out successively for lint index, seed weight and mean maximum halo length. The 106 plants that

remained were bulked to form 8MB. The mean lint yield of these plants was about 1% higher than the mean yield of the 200 original plants. This increase raises the theoretical cumulative total increment over the original bulk to about 29%.

A trial was laid out this season to test yield advance in the modal bulk series. Owing to an extremely unfavourable season, yields were very low, the mean yield of the trial being only 120 lb. of lint per acre, and there was no significant difference between stocks. The trial is to be repeated in the next season.

BP52 Progeny Rows.

Of the 62 progeny rows grown this season 60 were tested in randomised blocks with four replications. Fifty-six of the progenies had been selected in the previous season by the selection index technique. The mean yield of the 14 selected progenies was 7 per cent better than the yield of 7MB.

Small Bulks Trials.

Bulks of selected progenies from the previous season were grown at 5 localities, three at Namulonge as in previous seasons, and Kawanda and Bukalasa. At each locality an early and a late trial were sown, each with 3 replications. The early trials were sown on 21st June, and the late trials on 16th August. The mean yield of lint per acre for the early sown trials was 200 lb. and for the late trials 103 lb., so that late sowing resulted in a yield loss of about 50 per cent. The mean yield advance, from all localities, of the 9 progeny bulks over the 6MB control amounted to 28 per cent in the early sown trials, and 12 per cent in the late sown trials. The best progeny, C(53)9, was among the leaders in both early and late trials.

All strains in the trial were tested by the lint physiologist, and the results were very satisfactory. All progenies had a sorter grade of 2 or 2 minus. Estimates of proneness to form seed coat neps were made by the damaged seed count method, and in only one progeny, C(53)9, was a rather high figure (24 per cent) obtained. All other progenies gave counts between 9 and 15 per cent. A new multiline strain, to be known as BPQ, was made from the best of the C(53) progeny bulks after consideration of the yield data, the results of the quality tests and the Shirley Institute spinning tests on the C(53) progenies in the previous season. In the latter, all progenies had a yarn appearance rating of 3, and the values for the count × strength product were in most cases above 2,400. The BPQ strain will be tested in the small bulks trials and district variety trials next season.

Samples of lint of the best three strains and control from early and late trials in 3 localities have been sent to the Shirley Institute for small scale spinning tests.

District Variety Trials.

In this season, all five places in the district variety trials were occupied by strains selected out of BP52 at Namulonge. One multiline strain NC54, and 3 progeny bulks C(50)20, C(52)16 and C(52)18 were tested against 6MB as control. The multiline strain was composed of 5MB and 3 progeny bulks, C(50)20, C(50)17 and C(51)22, that were shown to be superior in earlier trials. Yields are summarised in Table 15. Significant differences were demonstrated in only two trials, so that over the whole range of trials the strains differed very little. The overall variety means for the 13 localities were estimated by weighting the means according to $^{r}/si^{2}$. The differences between actual and weighted means were not very large and the best strain C(52)18 was only some 5% better than the control. The three progeny bulks will form the basis of a new multiline strain to be known as NC55 which will be tested in next season's district variety trials, and grown as a bulk at Namulonge to provide seed for the first stage of multiplication in the following year.

The district variety trials will be used in future to test possible multiplication stocks. Material in the earlier stages of development will be tested in the breeding plots at Namulonge and in the small bulks trials.

Bacterial Blight Resistance.

Three breeding stocks were under selection for resistance to bacterial blight:—

(1) Progenies of Albar 51.

(2) Progenies of BP52.

(3) Crosses of Albar 51 selections with several strains of MU8 × BP52[2].

Albar 51.—137 single plant selections and 32 bulks were grown in this season. All plants were stem inoculated by the needle prick technique 10 weeks after planting, and susceptible plants were removed 3 to 4 weeks later. The percentage of resistant plants in many progenies was considerably lower than that found among their parents in the previous season. Of the 127 progenies grown in 1953-54, 48 consisted entirely of resistant plants. 63 of the progenies grown this season were derived from 34 of these homozygous strains, but in only 6 progenies was uniform resistance found. In the remaining progenies the proportion of susceptible plants varied from 2 to 70 per cent. A similar decrease in the proportion of resistant plants was observed in

TABLE 15.

SUMMARY OF VARIETY TRIALS WITH BP52 SELECTIONS, 1954-55.

CLEAN LINT LB. PER ACRE.

Variety	DIFFERENCES SIGNIFICANT.		DIFFERENCES NOT SIGNIFICANT.											*Mean Yields of 13 Trials*	
	Bukalasa July 5th	*Namyoya June 15th*	*Namulonge July 1st*	*Kawanda June 18th*	*Kalagala June 24th*	*Mukono June 15th*	*Kabasanda June 5th*	*Nkozi July 31st*	*Kisagazi July 23rd*	*Kyanamukaka June 24th*	*Kakumiro July 29th*	*Bukomero June 15th*	*Bulindi July15th*	*Actual*	*Weighted*
NC/54	517·4	348·5	141·2	308·9	331·1	211·2	258·7	187·4	256·1	224·4	207·2	231·0	454·1	282·5	281·5
6MB	500·3	299·6	132·0	312·8	330·0	228·5	232·3	186·1	248·2	205·9	242·9	234·9	435·6	276·1	280·2
C(52)16	531·9	349·8	149·2	315·5	372·2	233·6	207·2	194·0	278·5	232·5	221·8	237·6	473·9	292·1	282·5
C(52)18	543·8	365·6	146·5	315·5	360·4	244·2	244·2	182·2	271·9	207·2	220·4	237·6	417·8	289·0	293·9
C(50)20	559·7	326·0	139·9	306·2	345·8	242·9	236·3	224·4	258·7	191·4	219·1	237·6	407·9	284·3	288·6
Locality	530·6	337·9	141·8	311·8	347·9	232·1	235·7	194·8	262·7	212·3	222·3	235·8	437·4	284·8	
C.V.%	5·2	10·4	19·5	6·6	7·6	19·7	21·3	15·8	12·0	23·0	9·9	9·7	10·1		
L.S.D.	38	32	—	—	—	—	—	—	—	—	—	—	—		

the bulks. None of the progenies or bulks gave a higher proportion of resistant plants than its parent. An attempt was made, on a small scale, to test some progenies for boll resistance by a needle prick inoculation of the boll wall, but no useful results were obtained. The method will be repeated on a large scale next season, in conjunction with the atomiser method described in the previous report.

Bulks of resistant plants from all progenies were brought to the laboratory for analysis. Preliminary selection was made on ginning outturn, seed weight and lint length. A number of progenies gave ginning outturns as high as 40 per cent and a lint index of 6·5 or higher. Many progenies had rather short lint in this season, but several had halo lengths of over 34 mms. 90 bulks were tested by the lint physiologist. Several progenies were discarded for very high seed damage counts (in some cases over 40 per cent), and others for a high Rm-Ch value or low sorter grade. 12 progenies that gave very good results in the quality tests and were also satisfactory in their blackarm resistance, lint index and lint length were sent to the Shirley Institute for small scale spinning tests. 67 progenies in this series were selected for planting next season.

BP52.—90 progenies were grown and stem inoculated. As in the Albar material, there was a marked decrease in the proportion of resistant plants compared with the previous season. No progenies in this group were homozygous for stem resistance, the best progenies having between 50 and 60 per cent of their plants resistant. 30 progenies were discarded after selection in the field. Bulks of resistant plants from the remaining progenies, and 40 single plant selections, were analysed and tested in the laboratory. It was not possible to have all progenies tested by the lint physiologist, but amongst those that were tested, several gave high seed damage counts. 40 progeny bulks and 21 single plants were finally selected.

(*MU8* × *BP52*^{2}) × *Albar 51*.—The second generation of this hybrid material was grown, and all plants were stem inoculated and susceptible plants removed. The proportion of resistant plants varied from 10 to 50 per cent in the various crosses, the lowest proportion being found in crosses with the 503 strain of Albar 51, and the highest in those with the 474 strain.

Since future bacterial blight resistance work will probably be concentrated on this hybrid material, it is desirable to consider its history in detail. In the 1952-53 season, 7 strains of MU8 × BP52^2 were crossed with 4 strains of Albar 51, and in the next season seven F_1 bulks were grown. In each cross some plants were selfed and others backcrossed to MU8 × BP52^2. There are now 19 bulks of this hybrid material consisting of 7 "straight crosses", 7 backcrosses and 5 second backcrosses, to be regarded in future as distinct strains and known as

UPA strains. In this material it should be possible to select for a wide range of characters including jassid resistance and lint length, derived from the MU8 × $BP52^2$ parents, and bacterial blight resistance and high ginning outturn from the Albar parents.

In this season 92 single plants were selected from the bulks, and after preliminary selection for ginning outturn, seed weight and lint length, all bulks and single plants were tested by the lint physiologist. 62 single plants were finally retained, and the lint of 14 bulks has been sent to the Shirley Institute for small scale spinning tests.

Verticillium Wilt Resistance.

Strains of Albar 51 and B181 × BP50 were first stem inoculated with bacterial blight and susceptible plants removed. The surviving plants were inoculated with *Verticillium* wilt. In the Albar material very few plants showed any resistance, and it now appears that the removal of susceptible plants and retention of resistant plants over a period of several seasons has not succeeded in building up a high degree of resistance in Albar. In the B181 × BP50 material most plants showed resistance to the disease. A bulk of resistant plants was made from all the B181 × BP50 progenies and in future seasons will be kept as a "maintenance bulk" in which inoculation with wilt and removal of susceptible plants will be continued.

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Received August 1955.

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